The value of short-term pain relief in predicting the long-term outcome of 'indirect' cervical epidural steroid injections

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Abstract: BACKGROUND The predictive value of short-term arm pain relief after 'indirect' cervical epidural steroid injection (ESI) for the 1-month treatment response has been previously demonstrated. It remained to be answered whether the long-term response could be estimated by the early post-interventional pain course as well. METHODS Prospective observational study, following a cohort of n = 45 patients for a period of 24 months after 'indirect' ESI for radiculopathy secondary to a single-level cervical disk herniation (CDH). Arm and neck pain on the visual analog scale (VAS), health-related quality of life with the Short Form-12 (SF-12), and functional outcome with the Neck Pain and Disability (NPAD) Scale were assessed. Any additional invasive treatment after a single injection (second injection or surgery) defined treatment outcome as 'non-response'. RESULTS At 24 months, n = 30 (66.7%) patients were responders and n = 15 (33.3%) were non-responders. Non-responders exited the follow-up at 1 month (n = 10), at 3 months (n = 4), and at 6 months (n = 1). No patients were injected again or operated on between the 6- and 24-month follow-up. Patients with favorable treatment response at 24 months had significantly lower VAS arm pain ($p < 0.05$) than non-responders at days 6, 8-11, and at the 3-month follow-up. The previously defined cut-off of $> 50\%$ short term pain reduction was not a reliable predictor of the 24-month responder status. SF-12 and NPAD scores were better among treatment responders in the long term. CONCLUSIONS Patients who require a second injection or surgery after 'indirect' cervical ESI for a symptomatic CDH do so within the first 6 months. Short-term pain relief cannot reliably predict the long-term outcome.

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The value of short-term pain relief in predicting the long-term outcome of 'indirect' cervical epidural steroid injections.

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ABSTRACT

BACKGROUND: The predictive value of short-term arm pain relief after 'indirect' cervical epidural steroid injection (ESI) for the 1-month treatment response has been previously demonstrated. It remained to be answered whether the long-term response could be estimated by the early post-interventional pain course as well.

METHODS: Prospective observational study, following a cohort of n=45 patients for a period of 24 months after 'indirect' ESI for radiculopathy secondary to a single-level cervical disc herniation. Arm and neck pain on the visual analog scale (VAS), health-related quality of life with the Short Form-12 (SF-12), and functional outcome with the Neck Pain and Disability (NPAD) Scale were assessed. Any additional invasive treatment after a single injection (second injection or surgery) defined treatment as 'non-response'.

RESULTS: At 24 months, n=30 (66.7%) patients were responders and n=15 (33.3%) were non-responders. Non-responders exited the follow-up at 1 month (n=10), at 3 months (n=4), and at 6 months (n=1). No patients were injected again, or operated on between the 6- and 24-month follow-up. Patients with favorable treatment response at 24 months had significantly lower VAS arm pain ($p<0.05$) than non-responders at days 6, 8 – 11, and at the 3-month follow-up. The previously defined cut-off of >50% pain reduction was not a reliable predictor of the 24-month responder status. SF-12 and NPAD scores were better among treatment responders in the long-term.

CONCLUSIONS: Patients who require a second injection or surgery after 'indirect' cervical ESI for a symptomatic CDH do so within the first 6 months. Short-term pain relief cannot reliably predict the long-term outcome.

Keywords: arm pain; cervical disc herniation; epidural injection; long-term outcome; neck pain; nerve root; radicular pain.

Introduction

The 'indirect' cervical epidural steroid injection (ESI) technique described by Sutter et al.[23] advocates a safe approach for treating radicular pain secondary to a cervical disc herniation (CDH). Our workgroup has previously shown how – as a rule of thumb – >50% arm pain relief within the first week after computed tomography (CT)-guided 'indirect' cervical ESI could predict the 1-month treatment responder status.[13] In this follow-up study, we aimed to: 1) report long-term pain, health-related quality of life (HRQoL) and functional outcome in the cohort of our previous series of patients undergoing 'indirect' cervical ESI for symptomatic CDH;[15] 2) verify whether the long-term responder status could be predicted by short-term arm pain relief; and 3) identify any other clinical or radiological predictors of treatment response.

Methods

Between August 2013 and March 2015, all patients between 18 – 70 years of age with cervical radicular pain, with or without additional findings of radiculopathy (numbness, paresthesias, muscle weakness and diminished reflexes), secondary to a single-level CDH, were prospectively screened for study inclusion at the Department of Radiology at Cantonal Hospital St. Gallen in Switzerland. All injections were performed by A.N., a radiologist with special interest and over 20 years of expertise in ESI,[1] who also reviewed all diagnoses and magnetic resonance imaging (MRI) findings from the referring physicians (general practitioners, pain physicians, rheumatologists, orthopaedic surgeons and neurosurgeons).

Electrophysiology was not routinely part of the diagnostic work-up. Patients with pre-ESI arm pain <20/100 mm on the visual analog scale (VAS), red flags (severe motor deficit), myelopathy, multilevel disc herniation, concomittant stenosis, severe scoliosis, lack of symptom correlation with the imaging findings, previous ESI or surgery of the affected segment, uncorrectable bleeding diathesis, and a significant language barrier.[13]

Baseline parameters

Patient demographic data were collected before the injection. Profession according to the international standard classification of occupation,[12] work capacity in per cent, current use of opioids and symptom duration, as well as baseline intensity of arm and neck pain (VAS 0 to 100 mm), HRQoL (Short Form (SF)-12 questionnaire) and functional impairment (Neck Pain and Disability Scale[21] (NPAD)). As before,[13] CDH were classified as either preforaminal or foraminal based on MRI findings.

Injection technique

'Indirect' cervical ESI was performed according to Sutter et al.[23] under CT-fluoroscopy guidance (Siemens SOMATOM Emotion®, Munich, Germany) as previously described.[13] A Terumo Agani® needle, 18-G, Short Bevel (Zhejiang Kindly Medical Devices Co., Ltd., Zhejiang, China; Shanghai International Holding Corp. GmbH (Europe), Hamburg, Germany) and Chiba needle (ECOJEKT 23-G, 15 cm length, HS Hospital Service S.p.A., Aprilia, Italy) were used in coaxial technique to target the lateral aspect of the facet joint. Flashback/aspiration testing was performed and 0.3-0.5 ml saline-diluted iopamidol 300 mg/ml (Iopamiro 300®, Bracco Suisse SA, Manno, Switzerland) was applied and observed to spread around the

facet joint along the cervical root. Then, 4 mg dexamethasone (Mephameson®, Mepha Pharma AG, Basel, Switzerland) followed by 1 ml of 0.5% bupivacaine (Bupivacain Hydrochlorid®, Sintetica S.A., Mendrisio, Switzerland) were applied. After procedure, patients remained in the outpatient department for a minimum of 2 h for observation for any side effects.

Outcome measurements, endpoints and definition of responder and non-responder status

Patients received oral analgetics and physiotherapy as concomittant therapy that was not influenced by the study protocol. VAS arm and neck pain were recorded at the 15, 30 and 45 minute (min; ultra-early), 1, 2 and 4 hour (h; early) time points, on days 1-14 (d; intermediate), and at the 1-, 3-, 6-, as well as 12- and 24-month follow-up (long-term). At d14 as well as at each time point during the long-term follow-up, functional and HRQoL outcome, including opioid use, work capacity and satisfaction with ESI were assessed. When a study endpoint (second injection or surgery – anterior cervical decompression and fusion, or dorsal foraminotomy) was reached, the patient exited the follow-up and was considered non-responder. Responders had follow-up until 24 months after ESI.

Statistical considerations

Kaplan-Meier estimates response to treatment were graphically displayed. Log-rank tests were performed to analyze treatment failure distributions of two samples (time censored at 2 years). VAS arm and neck pain levels of responders and non-responders in the ultra-early, early, intermediate and long-term follow-up were compared. Accounting for variations in pre-interventional VAS pain levels, relative pain at follow-up was displayed with the former set as 100% as handled before.[13]

Functional (NPAD) and HRQoL outcome (SF-12) were graphically illustrated as absolute values for better interpretability.

Statistical between-group comparison for continous variables was performed using two-tailed unpaired t-tests. Chi-square tests were used to compare categorical variables. To be consistent with our previous report,[13] logistic regression was used to calculate the effect size of the relationship between >50% arm pain reduction at any given study visit, and the 24-month responder status; with results expressed as odds ratio and 95% confidence intervals. Since the study groups were well-balanced in important patient characteristics, no statistical adjustments were required.

The software used for analysis was Stata v14.2 (StataCorp LP, College Station, Texas, USA). GraphPad Prism v5.0c (GraphPad Software, Inc. San Diego, California, USA) was used for drawing Figure 2. Probability-values of <0.1 ($^{+}$) were considered a tendency, p-values of <0.05 (*) or <0.005 (**) were considered significant.

Ethical considerations and data management

Written informed consent was obtained from all included patients. The study was conducted in accordance with the ethical standards of the Cantonal Ethical Review Board St. Gallen, Switzerland (EKSG 13/061) with the Helsinki Declaration (1964, amended most recently in 2008) of the World Medical Association and registered under clinicaltrials.gov (Identifier: NCT01945554).

All data were collected by a full-time study nurse (C.L.). In order to conceal patients' identity, each study participant was given a unique patient number for follow-up questionnaires and data management.

Results

Out of 231 screened patients who underwent cervical ESI during the study period, 53 (22.9%) patients were found eligible for study inclusion. After the exclusion of eight patients (patient refusal for further participation; incomplete follow-up data), a total of 45 patients were available for final analysis. At the 24-month follow-up, 30 patients (66.7%) were considered responders and 15 (33.3%) non-responders. Non-responders exited the follow-up within 14 days (n=4; 2 second injection, 2 surgery); at 1 month (n=6; 1 second injection, 5 surgery), at 3 months (n=4; 4 second injection), at 6 months (n=1; 1 surgery). No patients were injected again or operated on between the 6- and 24-month follow-up (Figure 1).

Patient baseline data and procedure-related characteristics were well balanced between the two study groups with the exception of SF-12 physical component summary (Table 1). Two minor complications (4.4%; one transient episode of dizziness and one vasovagal syncope) were observed in the context of ESI.

Long-term arm and neck pain, functional and HRQoL outcome

Patients defined as responders were characterized by virtue of their significantly lower pain, functional, and HRQoL metrics, as well as reduced opioid use, better employment status and satisfaction with the treatment at 24 months, as compared to their counterparts (Table 2).

Figure 2 displays the different courses of VAS arm and neck pain of responders and non-responders over time. A significant drop in relative pain occurred within the first hours after ESI in all patients. Over the following days, an increase to about 40% of the pre-ESI pain level was observed in those considered responders at 24 months. Non-responders had significantly higher pain recurrence. While there were no significant between-group differences in terms of VAS arm pain in the ultra-early and

early follow-up, 24-months responders could be differentiated from non-responders in the intermediate interval, as indicated in the figure.

Effect size of the relationship >50% VAS arm pain relief and 24-month responder status

Table 3 illustrates the effect size of the relationship between >50% VAS arm pain relief at each time point and the 24-month responder status. In the intermediate period, at days 6 and 10 after ESI, patients experiencing >50% pain relief were 5.14 (95% CI 1.29 – 20.52) and 4.37 (95% CI 1.07 – 17.8) times as likely to be 24-months responders (Table 3).

Radiological predictors of treatment success

There was a non-significant trend for a higher rate of foraminal than preforaminal CDH in non-responders (Table 1). When stratifying the cohort by location, those with a CDH located in the foramen reached their study endpoints earlier as compared to patients with preforaminal CDH (Figure 3; log-rank p=0.116).

Discussion

Two-thirds of a prospective cohort of patients with symptomatic radicular pain secondary to a single-level CDH undergoing CT-guided 'indirect' cervical ESI did not require any extra procedures until the 24-month follow-up. Treatment failures became obvious within the first 6 months after the index procedure, and none of those considered responders required a second injection or surgery. Parallels can be drawn to a different prospective cohort of 57 patients who underwent transforaminal epidural injections for sciatica secondary to a lumbar disc herniation in which nearly all patients beyond the 6-month follow-up did not require additional invasive

treatment.[14, 15] Most likely, the favorable natural clinical long-term course of CDH with spontaneous regressions may obviate future treatment in many cases.[2] Another explanation for early re-treatment – as early as the first two weeks after the index procedure in our study cohort – may be cultural grounds, as patients from Switzerland seem to utilize their healthcare system on a lower threshold by requesting additional treatments with a short wait time.[14, 15]

Only a few studies have previously addressed outcome prediction of short-term cervical radicular pain relief following ESI. A positive correlation between the reduction in numeric rating scale cervical radicular pain 15 min after ESI for osteophyte-related radicular impingement with pain reduction in the first three months was established by Desai et al.[6] In another cohort of 21 patients with mixed diagnoses of cervical disc herniation and spondylosis awaiting surgery, five patients cancelled after receiving two ESI treatments; the authors noted that the long-lasting treatment effect was instantaneous.[17] On the other hand, Wald et al.[25] found the 2-month predictability of the 2-week numeric rating scale pain superior to the pain relief immediately after ESI. The 2-week interval post-ESI seems to be the most crucial, as in another study,[24] no further improvement beyond the 2-week follow-up was observed in those patients who had not responded by then. The aforementioned studies harbor significant methodological heterogeneities in terms of case mix[7, 17, 24, 25], multi-level[7, 24] and repeated injections[17, 24], omittance of local anesthetic[17, 24] and image guidance (fluoroscopy[17, 24] vs. CT[7, 25]). None of these studies followed their patients closely in order to work out a detailed course of treatment response.

Hence, in 2013, we started a prospective trial-registered (clinicaltrials.gov identifier NCT01945554) clinical observation study with predefined strict inclusion criteria on

clinical and radiological grounds, and validated assessment tools. As a main finding, predicting the 1-month treatment response was most successful in patients who experienced a >50% pain relief within the first week after ESI for lumbar disc herniations,[15] as well as for CDH,[13] which may aid physicians in managing these patients in the short-term. In the current long-term follow-up report, the previously established relationship between >50% pain reduction during any given time point and the 24-month responder status was weak and only statistically significant on d6 and d10 (Table 3). In conjunction with the recently published long-term results from our lumbar disc herniation cohort,[14] we have come to the conclusion that the value of short-term pain relief for the prediction of long-term outcome after ESI is low.

Early exits of patients who reached their endpoint (=treatment failures) limited the size of the follow-up cohort. As we acknowledged beforehand,[14] our study design did not include assessments of patients' pain levels, functional and HRQoL just before salvage treatment (second injection or surgery), which could have potentially strengthened the discriminative power of the graphs. Radiculopathy secondary to disc herniation has a heterogeneous and dynamic natural course of disease. For example, later re-current slippage of intervertebral disc material might prompt patients to opt for additional invasive treatment even if they had responded well to ESI in the beginning. Thus, the 50%-rule for predicting the 1-month outcome[13, 15] still holds true, but is complimented by the follow-up results of our current and recent publication[14] that underscore the uncertainties for the long-term predictability. Finding other clinical and radiological outcome predictors is warranted. Some authors[18-20] found pre-ESI pain duration to be a significant clinical predictor, while others could not establish a statistically significant effect.[5] A previous episode of cervical radiculopathy[20] and previous surgery[19] adversely affected outcome. Other than a lower SF-12 physical component summary in the non-responders, no

differences in baseline patient characteristics such as gender, body mass index, profession and employment status, or opioid use were noted in the current study, especially no difference in pain duration (Table 1).

Whether the etiology determines cervical ESI outcome is still a matter of debate. While some authors[17, 20, 22] found no difference in outcome with so-called “hard” (spondylosis) and “soft” (disc herniation) compression, others[8, 20] reported cervical ESI to be more effective in the setting of cervical spondylosis than disc herniation and vice versa.[18] We eliminated any possible bias arising from the preoperative diagnosis by excluding patients with cervical spondylosis and foraminal stenosis.

A few studies[16, 20, 22] looked into radiological predictors in greater detail. Strobel et al.[22] found a significant better response after cervical transforaminal ESI for foraminal (mean pain reductions of 64%; n=12) than for median or medio-lateral locations (41%; n=40). Radiological grading of nerve root compression did not result in statistically significant differences in pain relief.[22] Lee et al.[20] followed a cohort of 98 patients considered surgical candidates for cervical radiculopathy, who underwent ESI. There was no statistically significant difference in terms of location and extent of compression in patients, who later received surgery as compared to those who did not.[20] Likewise, Klessinger et al.[16] in their practice audit on patients after ESI found no statistically significant difference in treatment response with regard to the location or compression grade – a modification based on the system proposed by Ghahreman et al.[11] While the authors regard MRI as the gold standard technique for imaging work-up of cervical radicular pain, they critically emphasize that the inter-rater agreement between three blinded observers on the grading of nerve compression was poor with a Fleiss’ kappa = 0.1.[16]

The missing statistically significant association of radiological parameters with ESI outcome in the present report (as well as previously, for the 1-month outcome[13]), in

conjunction with the aforementioned conflicting or negative results, paints a picture of very limited predictive value of radiological features, if at all. Despite the promising report by Ghahreman et al.,[11] the usefulness of radiological predictors for lumbar ESI could not be reproduced by subsequent studies.[14, 15] The limitations of radiological grading scales to correlate with a patient's disability[4] or outcome[10] are well-known. Therefore, in the absence of red flags (severe/progressive motor deficit and cauda equina) requiring surgery, patient management with ESI up to now still mainly relies on individual experience, intuition and patient's preference and should take into account age, labor status, co-morbidities, and disease-specific factors.

Strengths and weaknesses

We previously discussed the strengths and weaknesses of the study design.[13] Some considerations for limitations include potential concomitant treatment confounders (non-standardized analgetics, physiotherapy), strict exclusion criteria that limit generalizability to other populations and a preferably larger sample size. Contrary to our previous publication,[13] VAS arm pain >80% was not considered a study endpoint in the current follow-up study because of the potentially inflicting long-term recall bias of the pre-ESI baseline pain at the 24-month follow-up.[13] Group differences between responders and non-responders were substantial and met the criteria for the commonly accepted minimum clinically important difference,[3, 9] which shows that the definition of the responder status was adequate.

Conclusions

Two-thirds of patients with radiculopathy secondary to a CDH will be long-term responders up to 24-months after 'indirect' cervical ESI. Most treatment failures

become evident within 6 months of the index procedure. The predictive value of short-term pain relief for the long-term responder status is unreliable, as are commonly recorded clinical and radiological variables.

FIGURE CAPTIONS

Figure 1: Kaplan-Meier curve illustrating treatment failure (defined as a second injection or surgery) after 'indirect' cervical epidural steroid injection (ESI) for radicular pain secondary to a cervical disc herniation over time. Y-axis: Rate of study participants. X-axis: Time in days after ESI. Note that no additional patients failed treatment between the 6- and 24-month follow-up.

Figure 2: Change in visual analog scale (VAS) arm (**A**) and neck pain (**B**) over time is illustrated for 30 and 15 patients who were considered responders and nonresponders at 24 months after 'indirect' cervical epidural steroid injection (ESI), respectively. *X-axis* Time after ESI in min, h, days and months. *Y-axis* Change in VAS pain (in %). $^{+}$ = $p<0.1$; * = $p<0.05$. Pain intensity is displayed in % (group means and standard errors), with pain intensity before ESI set at 100%.

Figure 3: Kaplan-Meier curve illustrating treatment failure (defined as a second injection or surgery) after 'indirect' cervical epidural steroid injection (ESI) for radicular pain secondary to a cervical disc herniation over time, stratified for patients with preforaminal and foraminal location of nerve root compression. *Y-axis* Rate of study participants. *X-axis* Time in days after ESI.

Compliance with ethical standards

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Conflict of interest Dr. Holger Joswig receives speaker honoraria from UCB Canada and travel grants from Medtronic. All other authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Ethical approval The study was conducted in accordance with the ethical standards of the Cantonal Ethical Review Board St. Gallen, Switzerland (EKSG 13/061) and with the Helsinki Declaration (1964, amended most recently in 2008) of the World Medical Association.

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Informed consent Written informed consent was obtained from all included patients.

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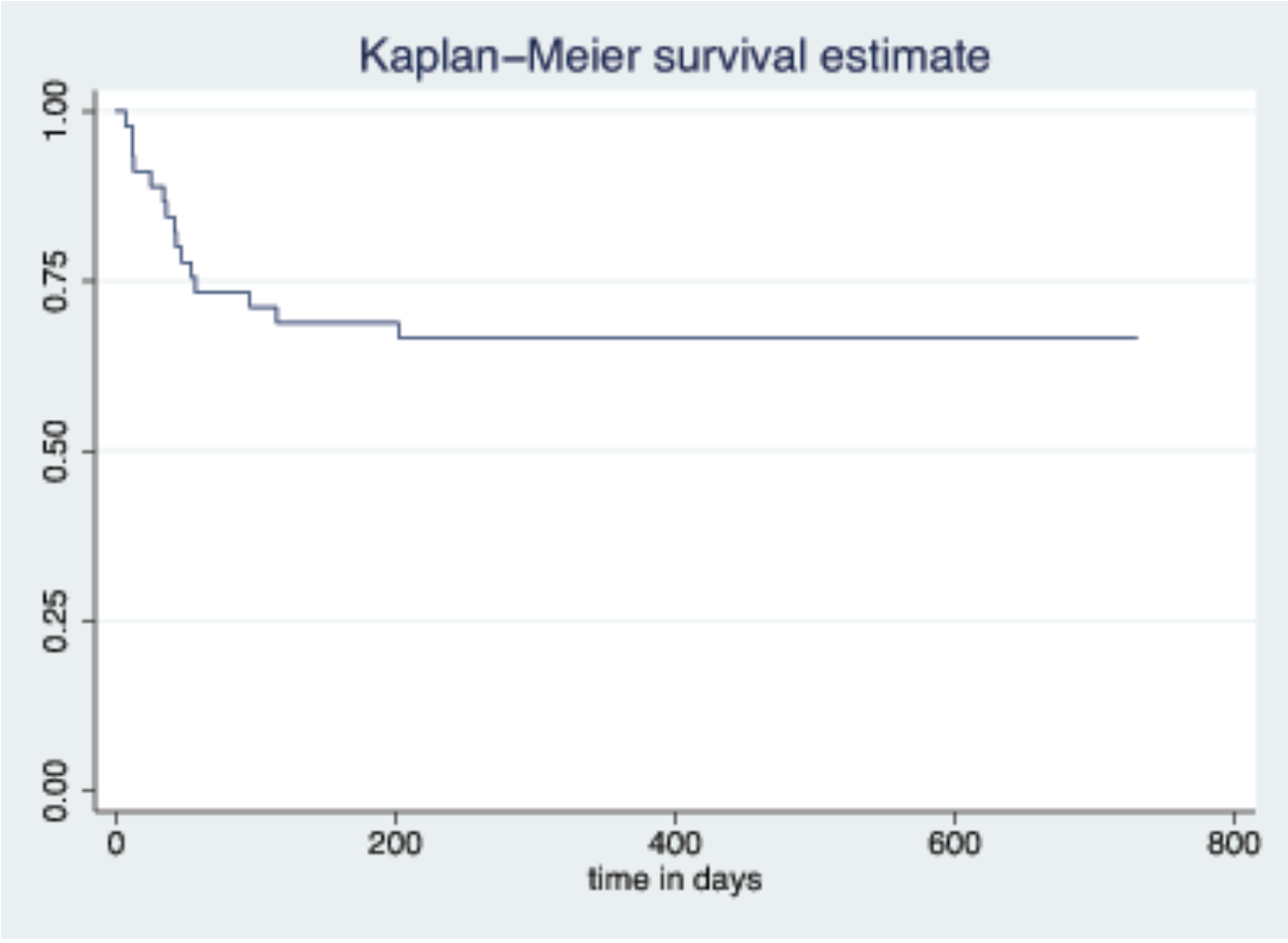
	Responder		Non-responder		p-value
Age in years	49.9 ± 9.4		51.3 ± 9.7		0.64
Gender					
Male	18	60.0%	9	60.0%	>0.99
Female	12	40.0%	6	40.0%	
Body metrics					
Height (cm)	172.4 ± 11.1		170.0 ± 7.5		0.46
Weight (kg)	76.6 ± 15.3		79.5 ± 26.5		0.65
BMI, (kg/m^2)	25.6 ± 3.3		27.6 ± 9.8		0.31
Professional life					
Pension	2	6.7%	2	13.3%	
Jobless	-	0.0%	1	6.7%	0.39
Home keeper	2	6.7%	-	0.0%	
Working	26	86.6%	12	80.0%	
Occupation (%)	71.5 ± 38.9		71.8 ± 42.1		0.98
ISCO group					
1 Managers	-	0.0%	-	0.0%	
2 Professionals	7	25.9%	5	41.7%	
3 Technicians	1	3.7%	-	0.0%	
4 Clerical support	2	7.4%	1	8.3%	0.95
5 Service/sale workers	9	33.3%	2	16.7%	
6 Skilled workers	-	0.0%	-	0.0%	
7 Craft/trade workers	4	14.8%	2	16.7%	
8 Plant/machine operator	2	7.4%	1	8.3%	
9 Elementary occupations	2	7.4%	1	8.3%	
Location of herniated disc					
Preforaminal	18	60.0%	5	33.3%	0.12
Foraminal	12	40.0%	10	66.7%	
Cervical nerve root affected					
C6	16	53.3%	5	33.3%	0.24
C7	12	40.0%	10	66.7%	
C8	2	6.7%	-	0.0%	
Side					
Right	17	56.7%	6	40.0%	0.29
Left	13	43.3%	9	60.0%	
Dose-length product (mGy*cm)	352.1 ± 123.5		358.2 ± 175.7		0.93
Complications					
Yes	1*	3.3%	-	0.0%	>0.99
No	29	96.7%	15	100%	
Opioid use					
Yes	10	33.3%	7	46.7%	0.38
No	20	66.7%	8	53.3%	
Delay pain onset to injection (days)	159.0 ± 273.1		92.7 ± 144.4		0.39
Pain, functional disability and HRQoL					
VAS arm	54.1 ± 16.1		63.7 ± 21.5		0.10
VAS neck	46.5 ± 23.3		50.9 ± 28.8		0.58
NPAD total	49.1 ± 16.2		59.7 ± 18.2		0.05
NPAD pain	16.1 ± 5.0		18.9 ± 4.9		0.08
NPAD disability	19.2 ± 8.1		23.9 ± 8.9		0.08
NPAD function	8.6 ± 4.6		10.1 ± 5.2		0.35
SF-12 PCS	39.1 ± 8.6		33.9 ± 5.2		0.04
SF-12 MCS	41.7 ± 10.1		42.8 ± 8.2		0.73
	n=30 (100%)		**n=15 (100%)**		

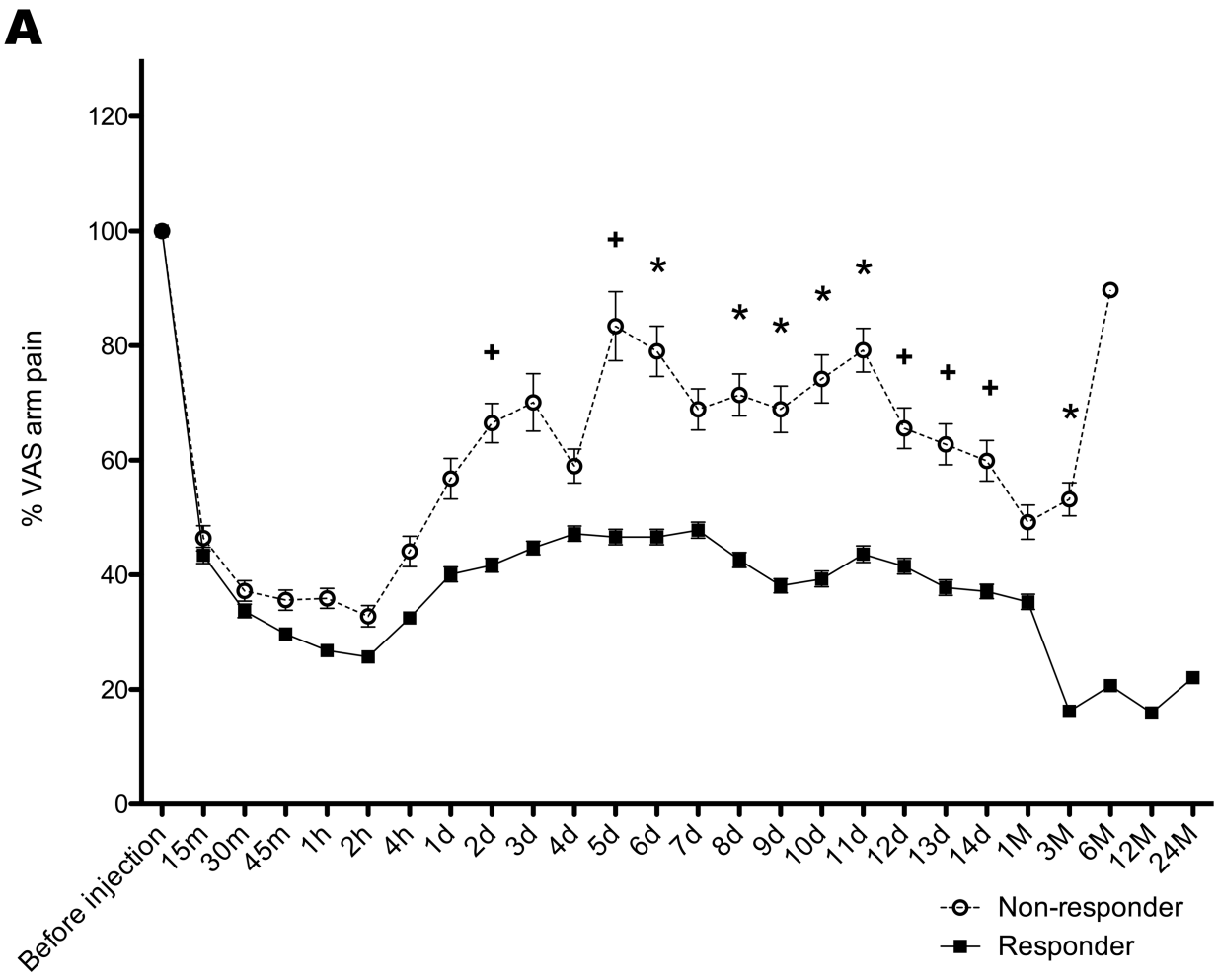
Table 1: Baseline and procedure-related characteristics of 30 and 15 patients considered responders and non-responders at 24 months after 'Indirect' cervical epidural steroid injections. Variables on an interval scale are presented as means with standard deviations (SD), and categorical variables as group counts and percent. Note that responders had slightly lower disease severity, as indicated by lower NPAD and higher SF-12 PCS values at baseline.

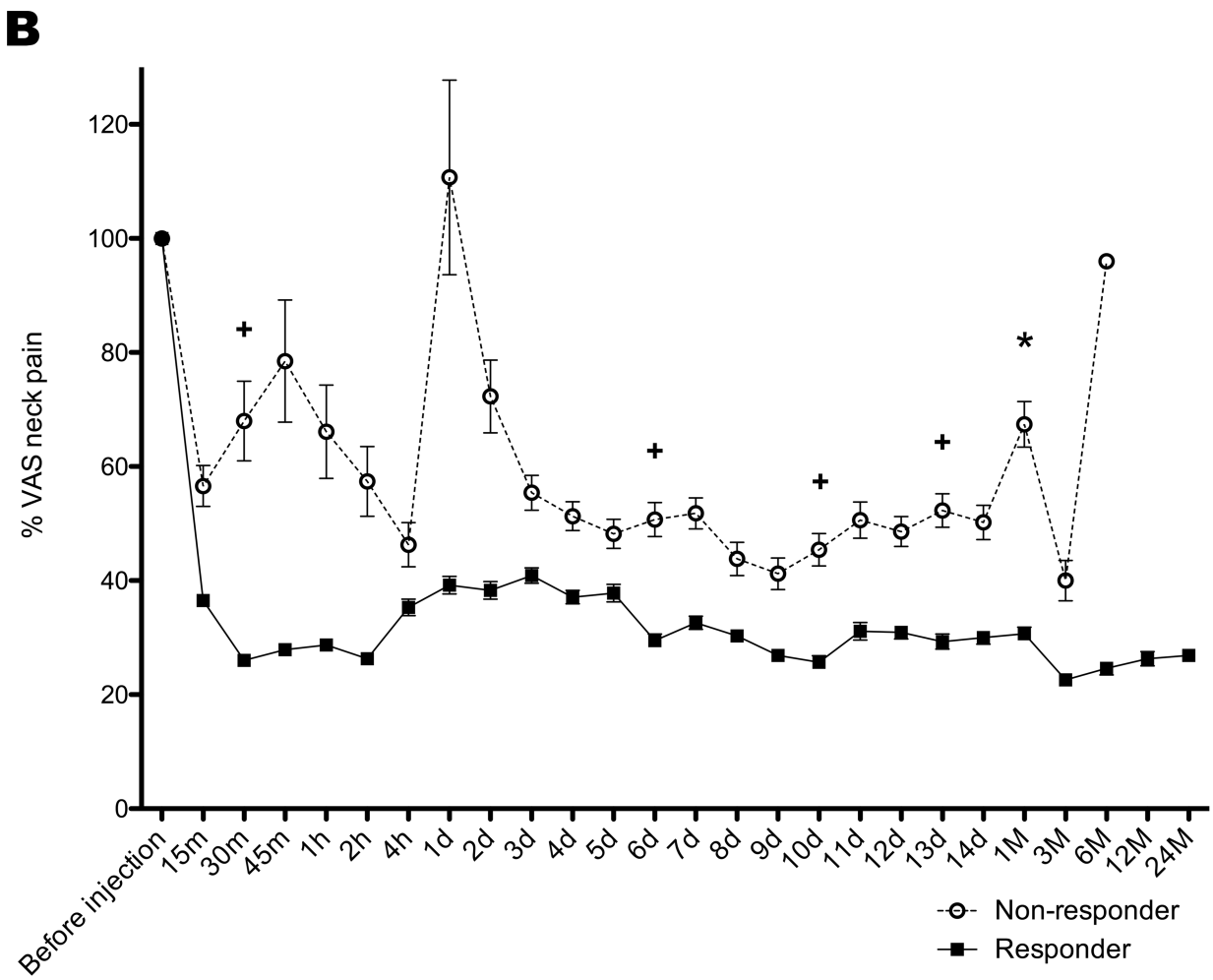
BMI, body mass index; *ISCO*, International Standard Classification of Occupations; *HRQoL* health-related quality of life, *VAS* visual analog scale, *NPAD* Neck Pain and Disability Index, *MCS* Mental Component Summary, *PCS* Physical Component Summary, *SF-12* Short Form-12.

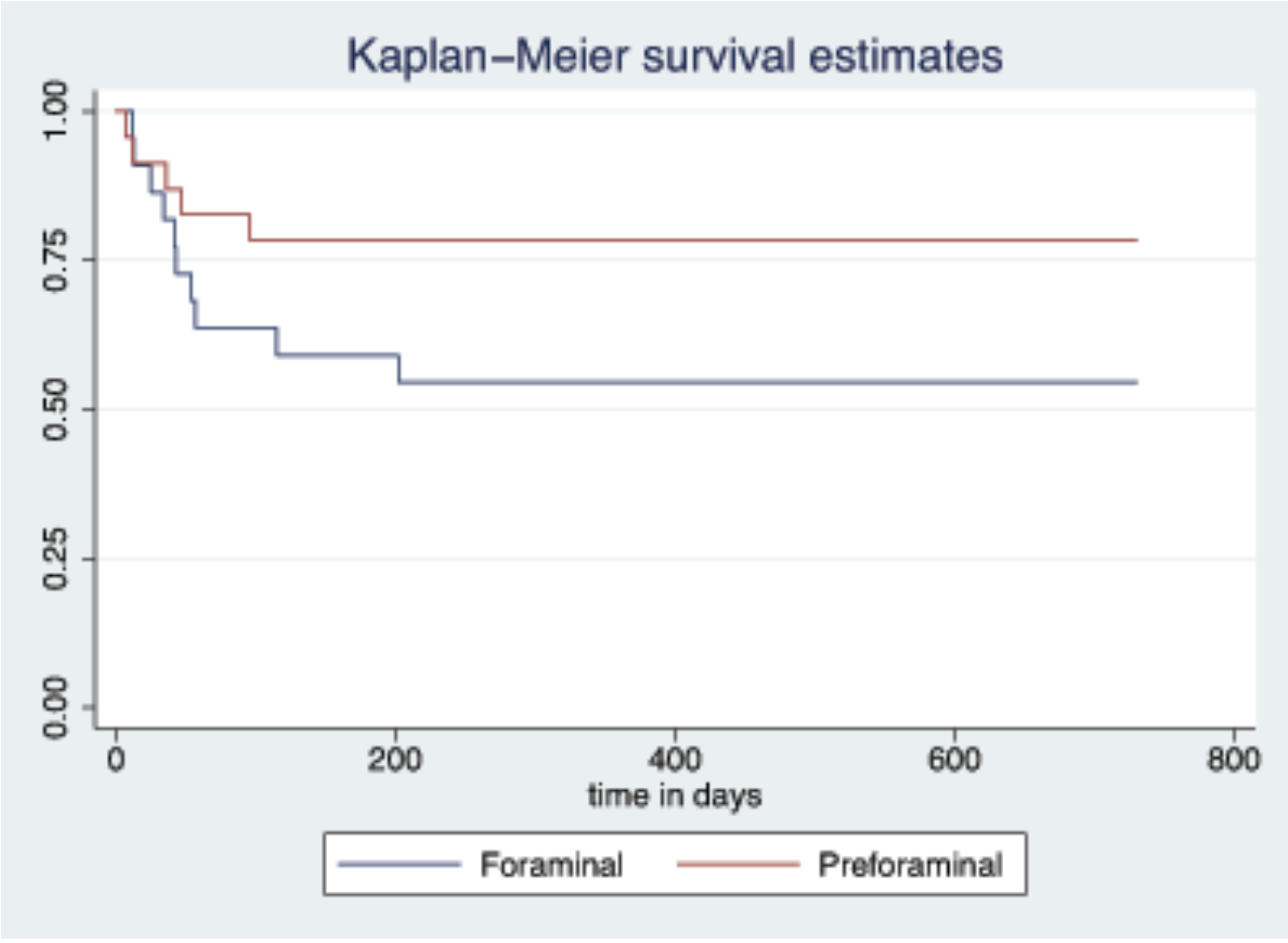
Outcome	Responder		Non-responder		p-value
Pain					
VAS arm	11.2 ± 12.4		49.3 ± 30.9		<0.001
VAS neck	15.0 ± 14.9		41.2 ± 30.3		<0.001
Functional disability					
NPAD total	11.0 ± 14.0		48.8 ± 27.1		<0.001
NPAD pain	4.3 ± 5.9		15.6 ± 8.2		<0.001
NPAD disability	3.9 ± 5.9		18.7 ± 11.9		<0.001
NPAD function	2.8 ± 3.6		9.3 ± 5.5		<0.001
HRQoL					
SF-12 PCS	49.4 ± 6.3		33.1 ± 7.6		<0.001
SF-12 MCS	48.4 ± 9.3		41.4 ± 7.8		0.019
Regular use of opioids					
Yes	1	3.3%	7	46.7%	<0.001
No	29	96.7%	8	53.3%	
Occupation in %	90.7 ± 21.4%		58.2 ± 44.5%		0.004
Survey					
Yes	22	73.3%	4	26.7%	
Certainly yes	15		4		
Probably yes	7		-		0.004
No	8	26.7%	11	73.3%	
Unsure	3		2		
Probably not	3		5		
Certainly not	2		4		
	n=30 (100%)		**n=15 (100%)**		

Table 2: Outcome of 30 and 15 patients considered responders (at 24 months) and non-responders (at last follow-up before exiting the study) after 'indirect' cervical epidural steroid injection. Nominal variables are presented as means with standard deviations (SD) and categorical variables as group counts and percent. *NPAD* neck pain disability index, *PCS* Physical component summary, *Survey* Patients were asked whether they would choose to have an injection again, provided they had the same outcome, *VAS* Visual analog scale.


Kaplan–Meier survival estimate
1.00
0.75
0.50
0.25
0.00
0
200
400
600
800
time in days


A
% VAS arm pain
120
100
80
60
40
20
0
Before injection
15m
30m
45m
1h
2h
4h
1d
2d
3d
4d
5d
6d
7d
8d
9d
10d
11d
12d
13d
14d
1M
3M
6M
12M
24M
Non-responder
Responder


B
% VAS neck pain
120
100
80
60
40
20
0
Before injection
15m
30m
45m
1h
2h
4h
1d
2d
3d
4d
5d
6d
7d
8d
9d
10d
11d
12d
13d
14d
1M
3M
6M
12M
24M
Non-responder
Responder


Kaplan–Meier survival estimates
1.00
0.75
0.50
0.25
0.00
0
200
400
600
800
time in days
Foraminal
Preforaminal